DOCUMENT RESUME

ED 038 829 EM 005 782

AUTHOR	Hilgard, Ernest R.
TITLE	A Basic Reference Shelf on Learning Theory. A Series One Paper from ERIC at Stanford.
INSTITUTION	Stanford Univ., Calif. ERIC Clearinghouse on Educational Media and Technology.
PUB DATE	Sep 67
NOTE	18p.
EDRS PRICE	EDRS Price MF-$0.25 HC-$1.00
DESCRIPTORS	*Annotated Bibliographies, *Educational Psychology, *Learning Theories, *Reference Materials, Response Mode

ABSTRACT

This reference work briefly identifies the salient principles of learning theory under the subdivisions: 1) S-R theory, 2) cognitive theory, and 3) motivation and personality theory. It also describes various approaches to practical problems via unified theories of learning. A seven-item annotated bibliography on learning theory and its applications is included. (MS)

ED038829

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A BASIC REFERENCE SHELF

ON LEARNING THEORY

By Ernest R. Hilgard

September, 1967

EM 005782

(Pp. 1-15 of this guide, on the applicability of learning principles and theories to media instruction, are excerpted from the 3rd edition of "Theories of Learning", p. 562-571, by Ernest R. Hilgard and Gordon H. Bower (New York, Appleton-Century-Crofts, 1966), with the permission of the authors and the publisher. For more information about the book itself, see p. 16).

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SOME "PRINCIPLES" POTENTIALLY USEFUL IN PRACTICE

The reason for writing "principles" in quotation marks is that the generalizations to be listed are mere summarizations of empirical relationships that hold rather widely, although many of them are not stated with sufficient precision to consider them to be "laws" of learning. Students of learning who have not devoted themselves primarily to problems of instruction can still give some very useful advice. Some of this advice comes from those whose orientation is toward S-R theories, some from those who are oriented toward cognitive theories, some from those whose concern is with motivation and personality. The following suggestions for practice are in large part acceptable to all parties (with reservations with respect to detailed applicability that the foregoing account of training research makes necessary); the assignment to one or another source is a matter of emphasis (and vocabulary) rather than an indication that the statement is controversial.[1]

A. *Principles emphasized within S-R theory*

1. the learner should be *active*, rather than a passive listener or viewer. The S-R theory emphasizes the significance of the learner's *responses*, and "learning by doing" is still an acceptable slogan.

2. *Frequency of repetition* is still important in acquiring skill, and in bringing enough overlearning to guarantee retention. One does not learn to type, or to play the piano, or to speak a foreign language, without some repetitive practice.

3. *Reinforcement* is important; that is, repetition should be under arrangements in which desirable or correct responses are rewarded. While there are some lingering questions over details, it is generally found

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[1] Hilgard, E. R. Learning theory and its applications. In W. Schramm (Editor), *New teaching aids for the American classroom.* Stanford: Institute for Communication Research (1960). Pp. 19-26.

that positive reinforcements (rewards, successes) are to be preferred to negative reinforcements (punishments, failures).

4. *Generalization* and *discrimination* suggest the importance of practice in varied contexts, so that learning will become (or remain) appropriate to a wider (or more restricted) range of stimuli.

5. *Novelty* in behavior can be enhanced through imitation of models, through cueing, through "shaping," and is not inconsistent with a liberalized S-R approach to learning.

6. *Drive conditions* are important in learning, but all personal-social motives do not conform to the drive-reduction principles based on food-deprivation experiments. Issues concerning drives exist within S-R theory; at a practical level it may be taken for granted that motivational conditions are important.

7. *Conflicts* and *frustrations* arise inevitably in the process of learning difficult discriminations and in social situations in which irrelevant motives may be aroused. Hence these have to be recognized and their resolution or accommodation provided for.

B. *Principles emphasized within cognitive theory*

1. The *perceptual features* according to which the problem is displayed to the learner are important conditions of learning (figure-ground relations, directional signs, "what-leads-to-what," organic interrelatedness). Hence a learning problem should be so structured and presented that the essential features are open to the inspection of the learner.

2. The *organization of knowledge* should be an essential concern of the teacher or educational planner. Thus the direction from simple to complex is *not* from arbitrary, meaningless parts to meaningful wholes, but instead from *simplified wholes* to *more complex wholes*. The part-whole problem is therefore an organizational problem, and cannot be dealt with apart from a theory of how complexity is patterned

3. *Learning with understanding* is more permanent and more transferable than rote learning or learning by formula. Expressed in this form the statement belongs in cognitive theory, but S-R theories make a related emphasis upon the importance of meaningfulness in learning and retention.

4. *Cognitive feedback* confirms correct knowledge and corrects faulty learning. The notion is that the learner tries something provisionally and then accepts or rejects what he does on the basis of its consequences. This is of course the cognitive equivalent of reinforcement in S-R theory but cognitive theory tends to place more emphasis upon a kind of hypothesis testing through feedback.

5. *Goal-setting* by the learner is important as motivation for learning and his successes and failures are determiners of how he sets future goals.

6. *Divergent thinking*, which leads to inventive solutions of problems or to the creation of novel and valued products, is to be nurtured along with *convergent* thinking, which leads to logically correct answers. Such divergent thinking requires the subject to perceive himself as potentially creative through appropriate support (feedback) for his tentative efforts at originality.

C. *Principles from motivation and personality theory*

1. The learner's *abilities* are important, and provisions have to be made for slower and more rapid learners, as well as for those with specialized abilities.

2. *Postnatal development* may be as important as hereditary and congenital determiners of ability and interest. Hence the learner must be understood in terms of the influences that have shaped his development.

3. Learning is *culturally relative*, and both the wider culture and the subculture to which the learner belongs may affect his learning.

4. *Anxiety level* of the individual learner may determine the beneficial or detrimental effects of certain kind of encouragements to learn. The generalization appears justified that with some kinds of tasks high-anxiety learners perform better if *not* reminded of how well (or poorly) they are doing, while low-anxiety learners do better if they *are* interrupted with comments on their progress.

5. The same objective situation may tap *appropriate motives* for one learner and not for another, as for example, in the contrast between those motivated by affiliation and those motivated by achievement.

6. The *organization of motives* and values within the individual is relevant. Some long-range goals affect short-range activities. Thus college students of equal ability may do better in courses perceived as relevant to their majors than in those perceived as irrelevant.

7. The *group atmosphere* of learning (competition vs cooperation, authoritarianism vs democracy, individual isolation vs group identification) will affect satisfaction in learning as well as the products of learning.

If one reviews such a list of suggestions as the foregoing, it becomes apparent that laboratory knowledge does not lead automatically to its own applications. Any teacher reading the list will say: "How can I do these desirable things, with the many pupils in my classes, and with the many demands upon me?" Or even: "How would I do it if I had only a single student to tutor?" As in the development of any technology, further steps are needed between the pure science stage and the ready application of what has been found out.

It is still worthwhile to attempt to assemble suggestions such as these from the general knowledge of learning, for then the steps of application will presumably be taken more economically.

APPROACHES TO PRACTICAL PROBLEMS VIA UNIFIED THEORIES

The effort to arrive at unified conceptions of learning is commendable. The scientific enterprise tends in general to favor elegant and simple theories; parsimony and esthetic appeal help guide the search for comprehensive theories. Within applied science, however, the constraints are somewhat different. For one thing, applied science cannot wait for the answers of pure science to come in: crops have to be planted and gathered, the sick have to be treated, and children have to be taught with whatever tools and knowledge are now available. It is natural that in the early development of the relevant sciences the applied users, the technologists,

will tend to be eclectic, picking up a plausible idea here and there, and using it somewhat inventively in the practical situation. Thus skilled teachers contribute to educational advance, with students of the psychology of learning sometimes bringing up the rear. Only when science is further advanced can pure science take the lead in developing practice, as it does in the aiming of shots to the moon.

The option is still open of atempting to guide practical developments by way of one or the other of the prevailing theories, or by developing some new model which has more unity than a set of eclectic "principles." Some psychologists have chosen this approach, and a number of their positions may be examined briefly in turn. The classical position in this respect was of course that of Thorndike, for his position on learning was developed as an educational psychology, with its emphasis upon elements, transfer, measurement, and the law of effect. The functionalism of John Dewey, although a related viewpoint, had a very different influence upon the schools; while his position was called "experimentalism" it was not synonymous with the "experimentation" of Thorndike, and, while victorious over Thorndike in some respects,[2] it did not lead to much research within educational psychology. The exciting newcomer on the field in the 1930's was gestalt psychology, which became the accepted educational psychology for a time, but its excesses in the hands of some of its educational enthusiasts, who were not experimentally oriented led to its declining influence.[3] We may, for illustrative purposes, consider four of the views represented in earlier chapters[4] in terms of some contemporaries who have

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[2] McDonald, F. J. The influence of learning theories on education. In E. R. Hilgard (Editor), *Theories of learning and instruction.* 63rd Yearbook of the Natl. Soc. Study Educ. Chicago: Univ. of Chicago Press (1964). Pp. 1-26.

[3] Hilgard, E. R. The place of Gestalt theory and field theories in contemporary learning theory. In *Theories of learning and instruction.* Chicago, Ill.: 63rd Yearbook, Part I. Nat'l Soc. for the Study of Education (1964). Pp. 54-77.

[4] See Guthrie, Skinner, Hull, and Gestalt. In E. R. Hilgard and G. H. Bower, *Theories of learning,* 3rd edition. New York: Appleton-Century-Crofts (1966).

attempted to use these theories in relation to practical problems, and then turn to one newer viewpoint, that of Gagné, which uses a hierarchical set of principles, possibly less unified than the major theories, but more unified than a sheer empiricism.

1. *Applications of Guthrie's contiguous conditioning.* In giving a rationale for their applied psychological research, Lumsdaine, Sheffield, and Maccoby, all at one time students of Guthrie, defer repeatedly to his theoretical position.

Lumsdaine,[5] for example, believes that much that is done in programmed learning can be accounted for better according to Guthrie's views than according to Skinner's. The chief issue is over *prompting* vs *shaping*.[6] According to Guthrie, one learns by assimilating cues to responses, so that the *cueing* of responses follows directly from his theory. The programmer frequently does just that: he tries to give enough cues to guarantee a high order of successful responses. Maintaining the responses with fewer stimulus supports ("fading") is also coherent with Guthrie's theory. This emphasis upon the *responses* of the learner, reflected in the title of one of the books that Lumsdaine edited, *Student responses in programmed instruction,*[7] follows from Guthrie's position that we learn what we do. Skinner's emphasis upon the role of reinforcement, by contrast, emphasizes the rewarding of approximate responses, and then, through differential reinforcement, strengthening those responses that better meet the specifications of what is wanted. While this works pretty well in free operant behavior, the programmed type of learning is more constricted, and, according to Lumsdaine, the practice accords more to cueing and prompting than to shaping.

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[5] Lumsdaine, A. A. Educational technology, programmed learning, and instructional sciences. In E. R. Hilgard (Editor), *Theories of learning and instruction.* Chicago: Univ. of Chicago Press (1964). Pp. 371-401.

[6] The notions of *prompting, shaping,* and *fading* are all from within Skinner's conceptions of programming. We are here concerned with the theory of their operation.

[7] Lumsdaine, A. A. (Editor) *Student response in programmed instruction: A symposium.* Washington, D. C.: National Academy of Sciences--National Research Council (1961).

Sheffield[8] outlined the theory that guided the work that he and Maccoby and their collaborators did on learning complex sequential tasks from combinations of filmed demonstrations and practice. Sheffield's theory is pure Guthrie[9] (association by contiguity, referred to as conditioning), except for an important amendment: perceptual responses are said to follow the same principles as motor responses. It must be noted that this does *not* mean that perceptual responses *are* motor responses (e.g., discriminatory reactions, subvocal speech, etc.), but rather that one can take them for what they are phenomenally, and then apply the associative rules to them.

> The position taken here is that what is usually called "perception" refers to cases in which the immediate sensory stimulation is not only eliciting its innate sensory responses, but is also eliciting other sensory responses which have been conditioned to the immediate stimulation in past experience.[10]

The word "response" has here lost its original behaviorist meaning of a muscular movement or a glandular secretion; a new category of innate response, *sensory response*, has been added, which, through conditioning, becomes a perceptual response. This gives Sheffield great freedom in introducing cognitive processes into an essentially S-R type of system. For example:

> In the same vein, a wristwatch is completely "transparent" to a skilled watch repairman. From the outside he can note the distinctive brand and model; this is sufficient for him to "fill in" all of the internal parts--their sizes, shapes, arrangements, and so forth. When he takes the watch apart he is completely prepared for everything he sees because his anticipatory conditioned sensory responses correspond with his immediate unconditioned sensory responses when he opens it and makes the inner works visible.[11]

Without questioning either the validity or the usefulness of the ideas embodied in this quotation, it is the kind of statement, which had it been expressed in terms of sensations and their revival as images, would

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[8] Sheffield, F. D. Theoretical considerations in the learning of complex sequential tasks from demonstration and practice. In A. A. Lumsdaine (Editor), *Student response in programmed instruction.* Washington, D. C.: National Academy of Sciences--National Research Council, Publication 943 (1961). Pp. 13-32.

[9] See discussion in Chapter 4, Hilgard and Bower (1966).

[10] Sheffield (1961), p. 15.

[11] Sheffield (1961), p. 16.

have been most repugnant to an early behaviorist. It is clear enough that a functionalist would accept such a statement, but even a contemporary S-R theorist must have some trouble with this kind of response. Having ignored this hurdle, Sheffield is able to do some very cogent theorizing about what goes on in sequence learning, and in response organization. Many of the conceptions have overtones of gestalt or cognitive theory, such as the distinction between *imposed* and *inherent* organization, "natural units" of a sequential task, perceptual "blueprinting." The concept of natural structure was much emphasized by Wertheimer, and the notion of mapping, as mentioned earlier, by Tolman. Although in Sheffield's opinion he has gone beyond gestalt or cognitive psychology in deriving their truths from conditioning theory, the major leap is to interpreting organization in perception as the conditioning of innate sensory responses. Whether or not one sees these additions as natural extensions or consequences of Guthrie's theory, from a practical standpoint one can only celebrate the trend toward consensus on some of the implications for instruction.

2. *Applications of Skinner's operant conditioning.* Part of Skinner's success in gaining adoption for programed learning (originally for the teaching machine) came because of his insistence that he was basing this instructional device strictly on what had been found out from his experiments on rats and pigeons. The major concepts of emitted response and its strengthening through carefully timed reinforcement, of the importance of reward over punishment, of shaping through small-step gains, of the subject's control of his own pace, all came from the experimental background of operant conditioning. In his original announcement of programed learning, Skinner[12] was very clear that he was deriving the principles of programed learning from his laboratory work; the child was simply a new organism to be studied:

> There are certain questions which have to be answered in turning to the study of any new organism. What behavior is to be set up? What reinforcers are at hand? What responses are available in embarking upon a program of progressive approximation which will

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[12] Skinner, B. F. The science of learning and the art of teaching. *Harvard educ. Rev.*, 24 (1954), pp. 86-97.

> lead to the final form of the behavior? How can reinforcements be most efficiently scheduled to maintain the behavior in strength? These questions are all relevant in considering the problem of the child in the lower grades.[13]

The notion of shaping through reinforcement is clearly implied. One of his associates enunciated the laboratory principles as they applied to programed learning as suggested by the following six topics:[14]

1. Immediate reinforcement.
2. Emitted behavior.
3. Gradual progression to complex repertoires.
4. Fading; gradual withdrawal of stimulus support.
5. Controlling observing (attentive) behavior.
6. Discrimination training (abstractions; concepts).

There can be little doubt that the background of laboratory experience contributed strongly to what was done in Skinner's laboratory as programing was introduced.

Several comments are in order. In the first place, the direct application of these principles has not proved to be universally the only efficient way in which to proceed. Reservations apply to immediate reinforcement, the necessity to emit behavior (in the form of constructed responses), even to some aspects of gradual progression. Others have also noted that Skinner has not moved as directly from his free operant model as his writings sometimes have suggested; for example, Zeaman[15] showed that it would be possible to consider programed learning as an illustration not of a free operant but of a controlled operant, and in some respects like classical conditioning. Finally, specific inventiveness, ingenuity,

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[13] Skinner (1954), p. 93.

[14] Holland, J. G. Teaching machines: An application of principles from the laboratory. In A. A. Lumsdaine and R. Glaser (Editors), *Teaching machines and programmed learning: A source book.* Washington, D. C.: National Education Association (1960). Pp. 215-228.

[15] Zeaman, D. Skinner's theory of teaching machines. In E. H. Galanter (Editor), *Automatic teaching: The state of the art.* New York: Wiley (1959). Pp 167-176.

and empiricism (revising programs through tryout) have played a role equal to that of any generalizations from the animal laboratory. Hence all credit is due to Skinner, but not necessarily on the basis of the authority of any principles learned from the rat or the pigeon.

3. *Drive-reinforcement theory applied in the Miller-Dollard version.* Miller and Dollard[16] introduced a simplified version of a theory very near to that of Hull in which they stressed the sequence drive-cue-response-reward, a theory since developed more fully by Miller.[17] Miller has shown that his less mathematical version of a theory similar in type to Hull's can be used to derive practical consequences. This is best illustrated by way of a small book on graphical methods in education that Miller edited, and much of which he wrote.[18]

In applying his theory to propose the conditions for maximum learning from motion pictures, Miller fell back upon the four-stage analysis he and Dollard had originally proposed:

1. Drive: The student must want something.
2. Cue: The student must notice something.
3. Response: The student must do something.
3. Reward: The student must get something he wants.

This manner of talking about what Hull would have talked about in terms of stimuli, reaction potential, habit strength, and drive, permits Miller to summarize the findings from experiments in a very sensible manner. The outline proved not quite sufficient, however, and he added another chapter after one on each of these four stages. The added chapter discussed such

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[16] Miller, N. E. and Dollard, J. *Social learning and imitation.* New Haven: Yale Univ. Press (1941).

[17] Miller, N. E. Liberalization of basic S-R concepts: Extensions to conflict behavior, motivation and social learning. In S. Koch (Editor), *Psychology: A study of a science,* Vol. 2. New York: McGraw-Hill (1959). Pp. 196-292.

[18] Miller, N. E. *Graphic communication and the crisis in education.* Washington, D. C.: National Educational Association (1957).

issues as the specificity versus generality of the influence of watching a teaching film, the superiority of logical over rote learning, meaningfulness and organization of material, forgetting and review, the value of demonstrating errors (as well as correct responses) in the visual material, dramatic versus expository presentation, types of audience, and the need to train students to profit from films.

While the theory thus provides a structure around which to give an exposition of research, a reader cannot but note how few of the principles from research of other kinds give any very direct guidance for motion picture learning, and how other principles, besides the more formal ones, seem necessary when a practical instructional situation is to be faced.

4. *The applicability of Gagné's hierarchical model.* The only new model being introduced here is that of Gagné.[19] He accepts eight types or categories of learning, each with its own rules, but arranges them in a hierarchy from simple to complex, on the assumption that each higher order learning depends upon the mastery of the one below it. Hence the theory is not strictly an eclectic theory (which chooses good principles from here and there without any order among them), but is the beginning of a unified theory on the assumption that appropriate transformation equations could be found for moving from one level to the next. The proposal of eight kinds of learning is sufficiently elaborated to be deserving of review.

His own summary of the eight types is as follows.[20]

Type 1. Signal learning. The individual learns to make a general diffuse response to a signal. This is the classical conditioned response of Pavlov.[21]

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[19] Gagné, R. M. *The conditions of learning.* New York: Holt, Rinehart and Winston (1965).

[20] Gagné (1965), pp. 58-59.

[21] Pavlov, I. P. *Conditioned reflexes.* London: Oxford Univ. Press (1927).

Type 2. Stimulus-response learning. The learner acquires a precise response to a discriminated stimulus. What is learned is a connection[22] or a discriminated operant,[23] sometimes called an instrumental response.[24]

Type 3. Chaining. What is acquired is a chain of two or more stimulus-response connections. The conditions for such learning have been described by Skinner[25] and others, notably by Gilbert.[26]

Type 4. Verbal association. Verbal association is the learning of chains that are verbal. Basically the conditions resemble those for other (motor) chains. However, the presence of language in the human being makes this a special type because internal links may be selected from the individual's previously learned repertoire of language.[27]

Type 5. Multiple discrimination. The individual learns to make *n* different identifying responses to as many different stimuli, which may resemble each other in physical appearance to a greater or lesser degree. Although the learning of each stimulus-response connection is a simple Type 2 occurrence, the connections tend to interfere with each other's retention.[28]

Type 6. Concept learning. The learner acquires a capability of making a common response to a class of stimuli that may differ from each other

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[22] Thorndike, E. L. Animal intelligence: An experimental study of the associative processes in animals. *Psychol. Rev. Monogr. Suppl.*, 2, No. 8 (1898).

[23] Skinner, B. F. *The behavior of organisms: An experimental analysis.* New York: Appleton-Century-Crofts (1938).

[24] Kimble, G. A. *Hilgard and Marquis' Conditioning and learning,* Second edition. New York: Appleton-Century-Crofts (1961).

[25] Skinner (1938).

[26] Gilbert, T. F. Mathetics: the technology of education. *J. Mathetics,* 1 (1962), pp. 7-73.

[27] Cf. Underwood, B. J. Laboratory studies of verbal learning. In E. R. Hilgard (Editor), *Theories of learning and instruction.* Chicago: Univ. of Chicago Press (1964). Pp. 133-152.

[28] Postman, L. The present status of interference theory. In C. N. Cofer (Editor), *Verbal learning and verbal behavior.* New York: McGraw-Hill (1961). Pp. 152-179.

widely in physical appearance. He is able to make a response that identifies an entire class of objects or events.[29]

Type 7. Principle learning. In simplest terms, a principle is a chain of two or more concepts. It functions to control behavior in the manner suggested by a verbalized rule of the form "If A, then B," where A and B are concepts. However, it must be carefully distinguished from the mere verbal sequence "If A, then B," which, of course, may be learned as Type 4.

Type 8. Problem solving. Problem solving is a kind of learning that requires the internal events usually called thinking. Two or more previously acquired principles are somehow combined to produce a new capability that can be shown to depend on a "higher-order" principle.

The notion that each of the higher stages requires the next lower as a prerequisite is limited for Gagné only by some uncertainty with respect to types 1 and 2; he is not convinced with Mowrer[30] that Type 2 has Type 1 as its essential background.

Gagné rejects the interpretation that learning is basically the same for all types; their differences are said to be more important than their similarities. Despite the position of conditioning at the base of the hierarchy, the sufficiency of conditioning is pointedly rejected:

> There can be little doubt that Watson's idea that most forms of human learning can be accounted for as chains of conditioned responses is wildly incorrect; and this has been pretty generally conceded for many years.[31]

It is intuitively clear that Gagné, having proposed so many different kinds of learning, will find it relatively easy to describe many kinds of school learning according to one or another of his types. It is not so clear, however, how he will work in the concept of hierarchy.

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[29] Cf. Kendler, H. H. The concept of the concept. In A. W. Melton (Editor), *Categories of human learning*. New York: Academic (1964). Pp. 212-236.

[30] Mowrer, O. H. *Learning theory and behavior*. New York: Wiley (1960).

[31] Gagné (1965), p. 13.

Two conceptions of hierarchy have to be distinguished. One of these is the hierarchy of learning types (from Type 1 through Type 8); another is the organization of knowledge according to hierarchies of principles, all of which may be, for example, at the learning level of Type 7. How Gagné deals with these matters can best be illustrated by examples.

Gagné has illustrated the hierarchical organization of school instruction, according to his types, for mathematics, science, foreign languages, and English.[32] The structure for reading is reproduced in Figure 16-4.

While there is a certain plausibility to such an outline as that of Figure 16-4, it is by no means clear that a sequence of instruction can be designed upon it, or that the basic notion is sound that the lower steps of the hierarchy have to be mastered before the higher steps can be learned. There may well be a kind of cyclical development in learning, in which the various stages repeatedly assert themselves.

When actual empirical studies are done, they tend to deal with the second concept of hierarchy, that is, of hierarchies of principles at a single stage of learning.[33] Gagné has used some principles implied in the understanding of the vector resolution of forces (all at the level of Type 7 in the hierarchy of learning types) to show what he means (Figure 16-5). In order to understand the principle at the top of the hierarchy (to identify horizontal and vertical components of forces as vectors) it is necessary to act in accordance with all of the principles lower in the hierarchy.

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[32] Gagné (1965), pp. 175-203.

[33] Gagné and others in R. Glaser (Editor), *Training research and education*. Pittsburgh: Univ. of Pittsburgh Press (1962). Pp. 223-246. Gagné, R. M., and Bassler, O. C. Study of retention of some topics of elementary non-metric geometry. *J. educ. Psychol.*, 54 (1963), pp. 123-131.

A strong emphasis within Gagné's analysis is upon *the structure of knowledge*, an important supplement to principles of learning whenever a practical instructional task is under consideration.[34]

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[34] Emphasis upon the structure of knowledge appears also in the writings of Bruner, whose position is well summarized in the oft-quoted hypothesis that "any subject can be taught effectively in some intellectually honest form to any child at any stage of development." See Bruner, J. S. *The process of education.* Cambridge, Mass: Harvard Univ. Press (1960), p. 33; and Bruner, J. S. Some theorems on instruction illustrated with reference to mathematics. In E. R. Hilgard (Editor), *Theories of learning and instruction.* Chicago: Univ. of Chicago Press (1964). Pp. 306-335. This position reflects to some extent an influence from Piaget, J. *The child's conception of number.* New York: Humanities Press (1952). The meaning of Piaget for learning theory has not been well enough worked out for exposition here, but attention may be called again to the work of Aebli, H. *Didactique psychologique; application à la didactique de la psychologie de Jean Piaget.* Neuchâtel: Delachaux et Niestlé (1951), and to the discussion of education and learning in Flavell, E. A. *The developmental psychology of Jean Piaget.* Princeton: Van Nostrand (1963). Pp. 365-379.

A SHORT BIBLIOGRAPHY ON LEARNING THEORY AND ITS APPLICATIONS

GENERAL REFERENCES

1. Hilgard, E. R., and Bower, G. H. *Theories of learning.* Third edition. New York: Appleton-Century-Crofts (1966). vi + 661 pp.

The authors give a sympathetic treatment of the major theories of the early twentieth century, theories associated with the names of Thorndike, Pavlov, Guthrie, Skinner, Hull, Tolman, Köhler, and Freud. The current residue from each of the theories is assessed. In addition, they treat current developments less specifically tied to "big names," such as functionalism, mathematical learning theory, information processing models, and neurophysiology. Somewhat uneven in difficulty, but designed to be understandable by the non-specialist.

2. Deese, J. E., and Hulse, S. *Psychology of learning.* Third edition. New York: McGraw-Hill (1967).

A treatment of the substantive problems of learning, with little emphasis upon the more general theories.

3. Walker, E. L. *Conditioning and instrumental learning.* Belmont, Calif.: Brooks/Cole (1967). xii + 161 pp. (Paper)

A shorter, very contemporary, introduction to theory, somewhat broader than its title implies. Includes chapters on imitation and modeling, as well as one on mathematical models. Well documented.

WITH SPECIAL REFERENCE TO HUMAN LEARNING AND APPLICATIONS

4. Hilgard, E. R. (Editor), *Theories of learning and instruction.* National Society for the Study of Education, 63rd Yearbook, Part I. Chicago: Distributed by University of Chicago Press (1964).

Current developments in learning theory are studied in their bearing upon educational practice in a number of chapters by authors such as

Bruner, Carroll, Gage, Glaser, Lumsdaine, McDonald, Pressey, Pribram, Pauline Sears, and Underwood.

5. Jones, J. C. *Learning*. New York: Harcourt, Brace & World (1967). xi + 179 pp. (Paper)

A lucid account of learning and motivation, including chapters on verbal behavior and concept formation, retention, transfer, and complex behavior (skills and problem solving). Designed for the professional education of teachers. Suggestions for further reading at end of each chapter stress applications.

6. Gagné, R. M. (Editor), *Learning and individual differences*. Columbus, Ohio: C. E. Merrill Books (1967).

Report of a conference participated in by high-level investigators, and concerned with the pressing problem of using knowledge of learning to help different learners.

7. Melton, A. W. (Editor), *Categories of human learning*. New York: Academic Press (1964). xvi + 356 pp.

A symposium in which each author's discussion of a conceptual problem is commented upon by another. The general direction is toward a classification ("taxonomy") of human learning.

NOTE: It was very difficult to keep this list short. Most of the books mentioned can serve as an introduction to a voluminous literature. - E. R. H.